PTO: 2003-5087

Japanese Published Unexamined (Kokai) Patent Publication No. 54-131041; Publication Date: October 11, 1979; Application No. S53-37488; Application Date: March 30, 1978; Int. Cl.^{2}: C03B 37/00 // G02B 5/14; Inventor: Akira Mita; Applicant: NEC Corporation; Japanese Title: Hikari Tsuushin-you Faibaa no Renzoku Seisan Houhou (Method for a Continuous Production of an Optical Communication Fiber)

Specification

1. Title of Invention

Method for a Continuous Production of an Optical Communication Fiber

2. Claim(s)

1. A method for a continuous production of an optical communication fiber that uses silica as a primary component and that has a step type refraction distribution, characterized in that at least silicon tetrachloride, chloride dopants and oxygen are supplied in a quartz reaction pipe container; high frequency plasma is generated at a reduced pressure at 100 torr or lower; these gaseous crude substances are vitrified so as to form reaction glass in the plasma at once; this glass is then supplied into an inner pot of a double structure pot that is provided at the lower part of the quartz reaction container so as to become the glass of a core portion; the glass in the inner pot is fused with glass that is supplied in an outer pot.

2. A method for a continuous production of an optical communication fiber, as disclosed in Claim 1, characterized in that the gaseous crude substances contain zinc, cadmium, tin or lead.

3. Detailed Description of the Invention

This invention pertains to total mass production methods with new structures.

Optical communication systems have recently been put to the practical use along with a significantly increased size of communication information and a development of an optical oscillation and detection optical communication systems is a difficulty on obtaining of high quality optical circuits at lower prices. As for practical optical fibers, silica fibers that contain silica as a main component and multi-component glass fibers that use alkali containing multi-component glass as the material are currently known. The former type is mainly produced by using a chemical vapor deposition (CVD) method and has characteristics such as a low loss and a high grade. On the other hand, it involves a high price. The latter type is produced at a relatively low cost because a continuous production is possible by the use of double structure crucibles. However, it is extremely difficult for it to reduce the loss as a purification of alkali metals is not easily applied.

With respect to the aforementioned viewpoints, a method that can continuously produce fibers by a double structure crucible without using alkali metals while silica is used as a main substance from gaseous phases has been increasing the popularity. However, prior art glass that uses silica as the main component has a relatively high softening point. Due to the high softening point, it is not suited for the continuous production or the water resistance is significantly weakened.

The purpose of the invention is to eliminate the disadvantages of the production method for prior art optical fibers and to offer a producing method for an optical fiber at a lower cost, which is suited for a mass production.

An effect of the invention is to enable glass with low water resistance to be used for a core, which cannot be used with prior art methods. Another effect is to obtain glass with a low softening point, which is in an outer region than prior art vitrification region.

The invention is achieved as follow. Low pressure plasma is generated in a part of a vertical quartz reaction pipe with a closed structure. Silicon tetrachloride and chlorides of various dopants or a metal are injected along with oxygen so as to form a glass material with a uniform composition. A continuous spinning is applied in a section provided at the lower part of the reaction pipe so that at least the core section if the optical communication fiber is formed using the glass material. Furthermore, by reacting zinc, cadmium, tin or lead as the dopant directly in the low pressure plasma in the form of metal steam, glass with a lower softening point with a lower refractive index, which has a composition other than the conventionally known vitrification region, is obtained.

In order to further clarify primary characteristics and advantages of the invention, an embodiment is described hereinbelow.

The drawing is a cross-sectional diagram illustrating a producing device for an optical communication fiber that enables a total mass production thereof. An oxygen gas is supplied from an opening 2 at the upper part of a pressure reducible quartz container 1. On the other hand, silicon tetrachloride and chlorides of various dopants such as boron trichloride, germanium tetrachloride and phosphorous trichloride ($POCl_3$) are mixed together using a conduit 3 conducted from the side. This mixture is further mixed with an oxygen carrier gas for a supply. A conduit 4 on the other side introduces zinc, cadmium, tin or lead steam into a reaction pipe from a heated metal accumulation 5 provided on pipe 4, using an argon gas as a carrier gas. When low pressure plasma 7 is generated in the

interior of the reaction portion via an inductive coil 6, the reaction instantaneously takes place at a high yield. As a result, glass with a uniform composition is formed. Obtained glass 8 is directly adhered on the inner wall or deposited on the lower part of the container. The lower part of the container is connected to an inner pot 14 of a double structure crucible 10 at an airtight state. A pulverized glass raw material is then supplied in an outer pot 13. The entire outer pot is heated to spin an optical fiber 11 from double structure crucible 10. An intake-exhaust hole 12 is provided at the lower part.

By using this type of device, a step type optical communication fiber is continuously produced. As in the embodiment, the glass formed if the high frequency input is slightly increased almost becomes a lump. It will not be necessary for it to perform a defoaming and a degassing by applying a bubbling for a long period as in the production of prior art glass. The glass that forms the core portion requires a low softening point and a high refractive index. In order for it to achieve the properties, the glass needs to contain dopants other than boron. Since a method that directly blows metal steam in the reaction portion is used for the invention, glass with a variety of compositions is produced. On the other hand, as the device is completely protected from the outside, a material with low water resistance can be used. For this reason, the glass is produced without using the metal chlorides, which are difficult to be handled. The glass that forms a clad portion requires a low softening point as similar to that of the core glass and a lower refractive index than that of the core glass. However, the requirement for the purity at the clad portion is more relaxed than that at the core portion. Water resistance is preferably given to the clad glass except for the case when the fiber is coated with plastic immediately after

the spinning. It is also necessary to have a lesser difference in the thermal expansion rates between the core glass and the clad glass.

In order to further achieve a complete continuous production method, a double structure pipe is used. A plasma reaction is alternately performed in the inner and outer pipes. After this, a spinning is performed by heating the lower part so as to achieve a more continuous fiber production. The vitrification by the gas reaction is also possible using constant pressure plasma. At the time, the reaction continuation level increases. However, the dopants volatile in many cases, and the glass forming range is reduced. In order to eliminate the disadvantages, the reaction is preferably performed at a reduced pressure, for example, 100 torr or lower.

Using this method, a total production method for an optical communication fiber is achieved by having silica as a primary composition and using the double structure pot.

4. Brief Description of the Invention

The drawing is a cross-sectional diagram illustrating a producing device for an optical communication fiber by the invention, which enables a continuous production.

1...Quartz container

2...Oxygen supplying opening

3...Crude gas conduit

4...Metal dopant conduit

5...Metal accumulation

6...High frequency induction coil

7...Low pressure plasma

8...Formed glass material

9...Clad glass conduit

10...Double structure crucible

11...Optical fiber

12...Exhaust hole

Translations Branch
U.S. Patent and Trademark Office
9/02/03
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